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Some physical and population characteristics of Egyptian mongooses (*Herpestes ichneumon* L., 1758) in southwestern Spain

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Abstract

Studied physical and population characteristics of Egyptian mongooses, *Herpestes ichneumon*, in southwestern Spain using trapping and radio-tracking. Males and females differed ($p = 0.04$) in body mass (3142 and 2823 g, respectively). Females were more often trapped than males (1.8F:1M), and adult than young (1.8A:1Y). Copulations occurred mainly (63.6 %) in March and April, and births (77.8 %) in May, June and July. The mean number of cubs per litter was 2.7 ± 0.8 ($N = 7$). Density for adult individuals was estimated as 1.2 ind./km^2. Annual survival rates were very low, oscillating between 0.13 in 1988/89 for adults and the same figure in 1987/88 for young, and 0.6 in 1987/88 for adults. After two years, life expectancy did not exceed 3 %. Of 16 dead mongooses, only 6.3 % were due to natural causes (predation), 25 % unknown, and the remainder from human activities, both direct (illegal hunting) and indirect (road kills).

Introduction

Egyptian or large grey mongoose, *Herpestes ichneumon*, is the only herpestid (Wozencraft 1989) with free-ranging populations in Europe (Corbet 1984; Carpaneto 1990), where its distribution is limited to the southwestern quadrant of the Iberian Peninsula. At the end of the last century it occurred in northwestern regions of Spain as well (Delibes 1982). The species is included in the Spanish Vertebrate Red Data Book, where its status is considered "unknown" (Icona 1986).

Except for some general data (Valverde 1960, 1967), and studies on its diet (Delibes et al. 1984; Palomares and Delibes 1991a, 1991b) and distribution (Delibes 1982), the biology and ecology of the Egyptian mongoose in Europe remain unknown. Recently, radio-tracking studies on time budget and spacing have been carried out in Doñana National Park (Beltrán et al. 1985; Delibes and Beltrán 1985; Palomares 1990; Palomares and Delibes 1991c). Here we describe some aspects of the physical and population characteristics of Egyptian mongooses in Doñana, including body mass, external measurements, sex and age proportions, reproduction, density, survival rates, and causes of mortality.

Material and methods

Trapping of mongooses and marking with radio-collars were carried out from September 1987 to September 1989 at Coto del Rey (Northern Doñana National Park, SW Spain, approx. 37°9′ N 6°26′ W) (Palomares 1990). Coto del Rey is almost completely reforested by pines, *Pinus pinea,* and eucalyptus, *Eucalyptus* sp., with undergrowth mainly of *Halimium halimifolium*. Small natural streams, where *Fraxinus* sp., *Populus alba, Pistacia lentiscus* and *Rubus* sp. grow, also occur. Patchily distributed over the area, associations of *Lentiscus* are found at sites with a higher water table. The climate is subhumid Mediterranean, characterized by dry, hot summers and wet, mild winters. The

terrain is flat and the soil is sandy. For more information about the study area, see VALVERDE (1958) and RIVAS-MARTÍNEZ et al. (1980).

Captured animals were sexed, weighed, and aged according to tooth wear (adults, with definitive and completely developed teeth; immatures, with definitive teeth, but with some teeth still growing; and young, with one milk tooth or more). The following body measurements were taken for every animal: head-body length, tail (terminal hairs not included) length, hilt height, hind-foot length and ear length.

Birth dates were obtained by estimating the age of the young individuals from body mass, head-body length and tail length when trapped, following BEN-YAACOV and YOM-TOV (1983). Courtship and copulation dates were estimated by direct observations from radio-collared individuals, and from data of birth dates, assuming a gestation period of 60–70 days (KINGDON 1977; BEN-YAACOV and YOM-TOV 1983). The number of cubs per birth was obtained from observation of family groups with at least one radio-collared individual, and by examining two pregnant females. Additionally, information on copulations, births, and litter size obtained in other sites in southern Spain and from captive individuals between 1973 and 1977 is also included.

Density was estimated from radio-tracking data of adult individuals. It was based on home range size and the percentage of overlap of the minimum area (minimum convex polygon method) where the trapping was undertaken (or trapping area; see MCLELLAN 1989, for a description of method). Since most mongooses were caught and tracked in 1988–89, we use the data from this period, although they are completed with those of the previous year (since home ranges seemed very stable although its dwellers changed; PALOMARES 1990). The home range of each individual was estimated by use of the minimum convex polygon method (MACDONALD et al. 1980), using only animals localized for 20 or more isolated times (time between locations was at least 4 hours; SWIHART and SLADE 1985; REYNOLDS and LAUNDRÉ 1990).

Rates of survival (annual and total for the two study years, for both adult and young, immatures included) were estimated from daily survival for the tracking period using MICROMOR program (HEISEY and FULLER 1985). Radio-collared mongooses and untagged animals frequently sighted together, were included in the analysis. Causes of death were determined from autopsy. The annual period to estimate survival rates of the young (see HEISEY and FULLER 1985) was early July to early February, the only period in which they were sighted and trapped in the study area (PALOMARES 1990).

Results

Physical characteristics

Only body mass was significantly different between males and females (means of 3142 g and 2823 g, respectively; $p = 0{,}04$, "t" test; Tab. 1). No other difference was significant ($p > 0.05$), although males appeared to be larger (Tab. 1).

Sex and age rates

Of 25 captured mongooses 9 were males and 16 females (1M:1.8F); the ratio did not differ significantly from equality ($\chi^2 = 1.960$, $p = 0.162$; Exact Test of WELLS and KING 1980). A

Table 1. **Mean and standard deviation (SD) of body mass (g) and external measurements (mm) of adult male and female Egyptian mongooses caught from September 1987 to September 1989 in Doñana National Park**

The "t" test and probability (p) values for comparisons of traits between sexes are given

	Mass[a]		Head-body[a]		Tail-base[a]		Hilt[a]		Back foot[a]		Ear[b]	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Males	3142.2	376.2	526.7	25.0	449.6	24.3	212.9	28.3	86.9	15.3	34.4	2.6
Females	2823.3	177.4	529.7	19.8	433.3	23.7	210.8	17.2	90.6	2.8	33.9	2.2
"t"	2.354		0.297		1.530		0.193		0.716		0.409	
p	0.040		0.771		0.144		0.851		0.495		0.689	

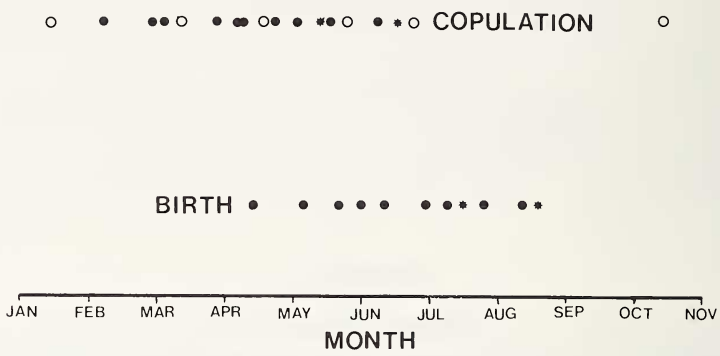
[a] N = 9 and 12 for males and females, respectively. – [b] N = 8 and 11 for males and females, respectively.

higher proportion of females was found in both young-immature (3M:6F) and adult (6M:10F) individuals. None of these proportions differed significantly from the expected 1:1 ratio (χ^2 = 0.78 and 0.51, p = 0.622 and 0.722, respectively), possibly due to small sampling size.

Young were trapped less often than adults (7 young, 2 immature and 16 adults; 1:1.8 between non-adults and adults). This proportion most likely changes throughout the year, since, as suggested by trapping data, the young grow quickly and can hardly be differentiated from adults at 9–12 months of age (Palomares 1990).

Reproduction

Courtship and copulation took place from early February to early June, with the peak frequency (63.6 %) in March and April, and births from mid April to mid August, with the peak frequency (77.8 %) from May to July (Figure). Valverde (1967) observed two births in July and August. In captivity copulation was observed in January, March, April, May, June and October (Figure).



Copulation and birth dates of Egyptian mongooses in Spain. Black circles = data obtained during field work of this study; open circles = observations obtained in captivity; asterisks = data from Valverde (1967)

The numbers of cubs observed in four family groups were 2, 3, 3, and 2. In two pregnant females 3 and 4 foetuses could be detected. On the other hand, a captive female gave birth to 2 cubs, and another had 3 foetuses. In total, the mean number of cubs per birth was 2.7 ± 0.8.

Density

Nine adult mongooses inhabited their entire or partial home range in the trapping area between January and August of 1989. However, the number of locations for a male was insufficient for estimating home range size, and this information was replaced by the data of another adult male, which occupied the same space one year previously. The total number of localizations for 3 males and 6 females was 807 (mean = 89.7, SD = 80.0, range = 20–259). Mean individual percentage of home range overlapping with the trapping area was 34.4 % (SD = 16.6, range = 4.0–61.4). Estimated density of adult mongooses was 1.2 ind./km^2. If we consider the above-estimated proportions of young and immature individuals in the population, the total density would be near 2 ind./km^2.

Causes of mortality and survival rates

Twenty-four of 25 trapped mongooses were equipped with radio-collars. Of these, one adult female was shot, one young female was killed by a dog, *Canis lupus* f. fam., or lynx, *Felis pardina,* and one adult male was caught in a poacher's foot-trap. The radio-collars of 3 other adult females, stopped sending, probably due to death of the animal. At least once, local people said that they had been killed by poachers. Of 5 mongooses not equipped with radio-collars but used to stay with a radio-collared animal, 4 might have died: two cubs of the shot female, and the other two which were no longer observed after a poacher had set foot-traps in their core areas.

Although in most cases confidence intervals are wide, annual survival rates were very low, oscillating between 0.13 in 1988/89 for adults and the same figure in 1987/88 for young, and 0.6 in 1987/88 for adults (Tab. 2). For adults, differences between years were significant ($Z = 2.03$, $p = 0.0212$). After two years, life expectancy did not exceed 8 % for both the adults and young (Tab. 2).

Table 2. **Numbers of individuals controlled (NC), deaths (ND) and survival rates of adult and young Egyptian mongooses in Coto del Rey during each study year**

95 % confidence limits are shown in parentheses. Number of days/mongoose for each period and age class was 592 and 707 in adults, and 209 and 426 in the young, for 1987/88 and 1988/89, respectively

	NC	ND	Survival
Adults			
1987/88	6	1	0.60 (0.22–1.0)
1988/89	11	4	0.13 (0.02–0.95)
Total	17	5	0.08 (0.01–0.73)
Young			
1987/88	4	2	0.13 (0.01–1.0)
1988/89	8	3	0.22 (0.04–1.0)
Total	12	5	0.03 (0.0 –0.78)

We have additional data since December 1985 on mortality of six mongooses from other locations in Doñana National Park. From 16 dead mongooses, 2 died in foot-traps, 2 others in road kills, 1 was captured in a snare, 1 was shot and 10 died from unknown causes. The last category includes 2 shot female cubs, and 2 young and one adult female most likely trapped by poachers. Accepting the evidence as valid, at least 56.3 % of these deaths were caused by illegal hunting, 12.5 % by indirect human action (road kills), 25 % by unknown causes, and only 6.3 % by natural causes (predation).

Discussion

Mongooses of Doñana have greater body mass than individuals trapped throughout southern Spain and Israel, and in both places body mass was significantly different for each sex (Ben-Yaacov and Yom-Tov 1983; Delibes et al. 1984). In Israel (the only country with data), head-body length was also significantly different between males and females.

Females were more often trapped than males; however, this situation is rare in carnivores (e.g., Gorman 1979; Buskirk and Lindstedt 1989, for a review in mustelids; Fuller 1989; Hellgren and Vaughan 1989). This result is usually attributed to the greater movements and larger home ranges of males, which are thus more inclined to enter traps (see Buskirk and Lindstedt 1989). Male mongooses had, as a rule, larger home ranges than females, and a higher number of core areas (Palomares 1990). This should have produced a higher probability of capture which, however, was not found. Since more young females than males (both roaming in family group; Palomares 1990) were also trapped, perhaps an unequal sex ratio could be the cause. Nevertheless, the spacing system of mongooses (with several females inside the territory of an adult male; Palomares 1990) could produce a reversed proportion is less favourable areas, where the males searching for an unoccupied territory would superabound. In captures in Cádiz country (southern

Spain) more males than females (30M:11F) occurred (Delibes, unpubl.). Adding the data of Doñana to the last mentioned site, the sex ratio is 1M:1F (N = 66).

Copulation and birth dates, and offspring size obtained in this study, are similar to data presented by Dücker (1965) for captive individuals. Nevertheless, with our method to calculate offspring size there is no guarantee for a lose of cubs, prior to observation dates. In fact, during the tracking period, a young was killed by a dog or lynx, and 2 others were lost under unusual circumstances (most likely killed by poachers), while still accompanied by their mothers. Birth dates overlap with yearly peaks of rabbit (*Oryctolagus cuniculus*) density (Beltrán 1991). Rabbits are the main prey of mongooses in this area (Palomares and Delibes 1991b).

Mongoose density outside the trapping area is lower than inside, since we studied the more favourable habitats and sites. On the other hand, a weak point of our method lies in the territoriality of the studied species and in the setting-up of the study-area boundaries. Both problems were solved by the home range exclusivity of mongooses in Doñana, especially males (Palomares 1990), and the determination of a "trapping area" according to McLellan (1989).

The lower survival rates and higher mortality due to human actions prove again that a National Park status is not sufficient guarantee of species conservation (Dasmann 1983), especially in the case of carnivores which need large home ranges and usually inhabit edges of protected areas (Ferreras et al. 1991). Only a high birth rate and immigration from other areas with lower mortality can explain the survival and the high relative density of the species in the study area.

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Zusammenfassung

Einige Daten zur Populationsbiologie des Ichneumons (Herpestes ichneumon L., 1758) in Südwest-Spanien

Eine Population des Ichneumons (*Herpestes ichneumon*) wurde über einen Zeitraum von zwei Jahren in Südwestspanien (Nationalpark Doñana) mit Hilfe von Fallenfängen und Radiomarkierung untersucht. Daten zu Körpergewicht und Größe, Geschlechtsproportionen, Altersstruktur, Fortpflanzung, Populationsdichte, Überlebensrate und Sterblichkeitsursachen werden mitgeteilt. Die Geschlechter unterscheiden sich nur im mittleren Gewicht (3142 g bei Männchen und 2823 g bei Weibchen). Weibchen fingen sich öfter in Fallen als Männchen, unabhängig vom Alter (1,8W:1M). Paarungen wurden hauptsächlich im März und April (63,6 %), Geburten im Mai, Juni und Juli (77,8 %) registriert. Die Wurfgröße betrug 2,7 ± 0,8 (N = 7). Die Populationsdichte für adulte Ichneumons wird auf 1,2 Ind./km^2 geschätzt. Die jährliche Überlebensrate war trotz breiter Konfidenzintervalle sehr niedrig; 0,6 (1987/88) und 0,13 (1988/89) für Adulte, und 0,13 (1987/88 für Jungtiere. Wenn beide Jahre miteinbezogen werden, dann überschreitet die Überlebensrate keine 3 %, sowohl bei Adulten wie bei Jungtieren. Die Mortalität von 16 aufgefundenen Tieren war in 6,3 % der Fälle auf natürliche Ursachen (Prädatoren) zurückzuführen; 25 % der Fälle bleiben ungeklärt, und in den übrigen Fällen waren entweder illegale Jagd oder der Straßenverkehr verantwortlich.

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